Import all packages

In [ ]:
```python
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import LabelEncoder
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import f1_score
from xgboost import XGBClassifier
from sklearn.svm import SVC
import scipy.stats as stats
import matplotlib.pyplot as plt
import seaborn as sns
```

Import datasets and setting indexes

In [ ]:
```python
# Load training (train) and test (test) data
test_data = pd.read_csv('Project_test_dataset.csv')
test_data.head()
```

Out[ ]:

	Student ID	Program	Student Gender	Experience Level	Student Siblings	Student Family	Financial Background	School Dormitory	School of Origin	Student Social Influence	Favourite Study Element
0	836	Magi Academy	female	39.0	1	1	83.1583	Mystical Chamber	Eldertree Enclave	16	Fire
1	323	Witchcraft Institute	female	30.0	0	0	12.3500	NaN	Arcan Institute	1	Earth
2	117	Sorcery School	male	70.5	0	0	7.7500	NaN	Arcan Institute	9	Earth
3	444	Witchcraft Institute	female	28.0	0	0	13.0000	NaN	Mystic Academy	9	Air
4	619	Witchcraft Institute	female	4.0	2	1	39.0000	Python Quarters	Mystic Academy	8	Water

In [ ]:
```python
test_data = test_data.set_index('Student ID')
```

In [ ]:
```python
train_data = pd.read_csv('Project_train_dataset.csv')
train_data.head()
```

Out[ ]:

	Student ID	Program	Student Gender	Experience Level	Student Siblings	Student Family	Financial Background	School Dormitory	School of Origin	Student Social Influence	Favourite Study Element	Admitted in School
0	1	Sorcery School	male	22.0	1	0	7.2500	NaN	Mystic Academy	18	Fire	0
1	2	Magi Academy	female	38.0	1	0	71.2833	Cottage Chamber	Eldertree Enclave	7	Fire	1
2	3	Sorcery School	female	26.0	0	0	7.9250	NaN	Mystic Academy	12	Air	1
3	5	Sorcery School	male	35.0	0	0	8.0500	NaN	Mystic Academy	12	Air	0
4	6	Sorcery School	male	NaN	0	0	8.4583	NaN	Arcan Institute	11	Earth	0

In [ ]:
```python
train_data = train_data.set_index('Student ID')
```

Check if there is missing data.

In [ ]:
```python
test_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 176 entries, 836 to 653
Data columns (total 10 columns):
 #   Column                    Non-Null Count  Dtype  
---  ------                    --------------  -----  
 0   Program                   176 non-null    object 
 1   Student Gender            176 non-null    object 
 2   Experience Level          145 non-null    float64
 3   Student Siblings          176 non-null    int64  
 4   Student Family            176 non-null    int64  
 5   Financial Background      176 non-null    float64
 6   School Dormitory          49 non-null     object 
 7   School of Origin          176 non-null    object 
 8   Student Social Influence  176 non-null    int64  
 9   Favourite Study Element   176 non-null    object 
dtypes: float64(2), int64(3), object(5)
memory usage: 15.1+ KB
```

In [ ]:
```python
train_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 713 entries, 1 to 889
Data columns (total 11 columns):
 #   Column                    Non-Null Count  Dtype  
---  ------                    --------------  -----  
 0   Program                   713 non-null    object 
 1   Student Gender            713 non-null    object 
 2   Experience Level          567 non-null    float64
 3   Student Siblings          713 non-null    int64  
 4   Student Family            713 non-null    int64  
 5   Financial Background      713 non-null    float64
 6   School Dormitory          153 non-null    object 
 7   School of Origin          713 non-null    object 
 8   Student Social Influence  713 non-null    int64  
 9   Favourite Study Element   713 non-null    object 
 10  Admitted in School        713 non-null    int64  
dtypes: float64(2), int64(4), object(5)
memory usage: 66.8+ KB
```

Fill missing values

In [ ]:
```python
XL_train = train_data['Experience Level']
XL_train = XL_train.dropna()
XL_test = test_data['Experience Level']
XL_test = XL_test.dropna()
```

In [ ]:
```python
m_train = round(XL_train.mean())
m_test = round(XL_test.mean())
```

In [ ]:
```python
train_data['Experience Level'].fillna(m_train, inplace=True)
train_data['School Dormitory'].fillna('Unknown', inplace=True)
test_data['Experience Level'].fillna(m_test, inplace=True)
test_data['School Dormitory'].fillna('Unknown', inplace=True)
```

Check the importance of categorical columns for the prediction

In [ ]:
```python
def TestIndependence(X,y,var,alpha=0.05):
    '''receive as arguments the dataset of independent variables, the target,
    the name of each independent variable and the alpha defined. This function will
    follow the steps of chi-square to check if a independent variable is an important predictor'''

    dfObserved = pd.crosstab(y,X)
    chi2, p, dof, expected = stats.chi2_contingency(dfObserved.values)
    dfExpected = pd.DataFrame(expected, columns=dfObserved.columns, index = dfObserved.index)
    if p<alpha:
        result="{0} is IMPORTANT for Prediction".format(var)
    else:
        result="{0} is NOT an important predictor. (Discard {0} from model)".format(var)
    print(result)
```

In [ ]:
```python
train_data_c = train_data.select_dtypes(include=['object'])
for var in train_data_c:
    TestIndependence(train_data_c[var],train_data['Admitted in School'], var)
```

```
Program is IMPORTANT for Prediction
Student Gender is IMPORTANT for Prediction
School Dormitory is IMPORTANT for Prediction
School of Origin is IMPORTANT for Prediction
Favourite Study Element is NOT an important predictor. (Discard Favourite Study Element from model)
```

Change categorical values to numeric

In [ ]:
```python
train_data.loc[train_data['School Dormitory'] == 'Unknown', 'School Dormitory'] = 0
train_data.loc[train_data['School Dormitory'] == 'Mystical Chamber', 'School Dormitory'] = 1
train_data.loc[train_data['School Dormitory'] == 'Cottage Chamber', 'School Dormitory'] = 2
train_data.loc[train_data['School Dormitory'] == 'Dragon Room', 'School Dormitory'] = 3
train_data.loc[train_data['School Dormitory'] == 'Tangerine Rooms', 'School Dormitory'] = 4
train_data.loc[train_data['School Dormitory'] == 'Python Quarters', 'School Dormitory'] = 5
train_data.loc[train_data['School Dormitory'] == 'Grand Chambers', 'School Dormitory'] = 6
train_data['School Dormitory'] = train_data['School Dormitory'].astype(int)
test_data.loc[test_data['School Dormitory'] == 'Unknown', 'School Dormitory'] = 0
test_data.loc[test_data['School Dormitory'] == 'Mystical Chamber', 'School Dormitory'] = 1
test_data.loc[test_data['School Dormitory'] == 'Cottage Chamber', 'School Dormitory'] = 2
test_data.loc[test_data['School Dormitory'] == 'Dragon Room', 'School Dormitory'] = 3
test_data.loc[test_data['School Dormitory'] == 'Tangerine Rooms', 'School Dormitory'] = 4
test_data.loc[test_data['School Dormitory'] == 'Python Quarters', 'School Dormitory'] = 5
test_data.loc[test_data['School Dormitory'] == 'Grand Chambers', 'School Dormitory'] = 6
test_data['School Dormitory'] = test_data['School Dormitory'].astype(int)
```

In [ ]:
```python
train_data.loc[train_data['School of Origin'] == 'Mystic Academy', 'School of Origin'] = 1
train_data.loc[train_data['School of Origin'] == 'Eldertree Enclave', 'School of Origin'] = 2
train_data.loc[train_data['School of Origin'] == 'Arcan Institute ', 'School of Origin'] = 3
train_data['School of Origin'] = train_data['School of Origin'].astype(int)
test_data.loc[test_data['School of Origin'] == 'Mystic Academy', 'School of Origin'] = 1
test_data.loc[test_data['School of Origin'] == 'Eldertree Enclave', 'School of Origin'] = 2
test_data.loc[test_data['School of Origin'] == 'Arcan Institute ', 'School of Origin'] = 3
test_data['School of Origin'] = test_data['School of Origin'].astype(int)
```

In [ ]:
```python
train_data.loc[train_data['Program'] == 'Sorcery School', 'Program'] = 1
train_data.loc[train_data['Program'] == 'Magi Academy', 'Program'] = 2
train_data.loc[train_data['Program'] == 'Witchcraft Institute', 'Program'] = 3
train_data['Program'] = train_data['Program'].astype(int)
test_data.loc[test_data['Program'] == 'Sorcery School', 'Program'] = 1
test_data.loc[test_data['Program'] == 'Magi Academy', 'Program'] = 2
test_data.loc[test_data['Program'] == 'Witchcraft Institute', 'Program'] = 3
test_data['Program'] = test_data['Program'].astype(int)
```

In [ ]:
```python
train_data.loc[train_data['Student Gender'] == 'male', 'Student Gender'] = 1
train_data.loc[train_data['Student Gender'] == 'female', 'Student Gender'] = 2
train_data['Student Gender'] = train_data['Student Gender'].astype(int)
test_data.loc[test_data['Student Gender'] == 'male', 'Student Gender'] = 1
test_data.loc[test_data['Student Gender'] == 'female', 'Student Gender'] = 2
test_data['Student Gender'] = test_data['Student Gender'].astype(int)
```

In [ ]:
```python
test_data = test_data.drop('Favourite Study Element', axis = 1)
train_data = train_data.drop('Favourite Study Element', axis = 1)
train_data.head()
```

Out[ ]:

	Program	Student Gender	Experience Level	Student Siblings	Student Family	Financial Background	School Dormitory	School of Origin	Student Social Influence	Admitted in School
Student ID										
1	1	1	22.0	1	0	7.2500	0	1	18	0
2	2	2	38.0	1	0	71.2833	2	2	7	1
3	1	2	26.0	0	0	7.9250	0	1	12	1
5	1	1	35.0	0	0	8.0500	0	1	12	0
6	1	1	30.0	0	0	8.4583	0	3	11	0

In [ ]:
```python
test_data.head()
```

Out[ ]:

	Program	Student Gender	Experience Level	Student Siblings	Student Family	Financial Background	School Dormitory	School of Origin	Student Social Influence
Student ID									
836	2	2	39.0	1	1	83.1583	1	2	16
323	3	2	30.0	0	0	12.3500	0	3	1
117	1	1	70.5	0	0	7.7500	0	3	9
444	3	2	28.0	0	0	13.0000	0	1	9
619	3	2	4.0	2	1	39.0000	5	1	8

Split train dataset to train and validation.

In [ ]:
```python
# Separates the characteristics (X) and the target variable (y) in the training set.
X = train_data.drop('Admitted in School', axis=1)
y = train_data['Admitted in School']
```

Check correlation between columns

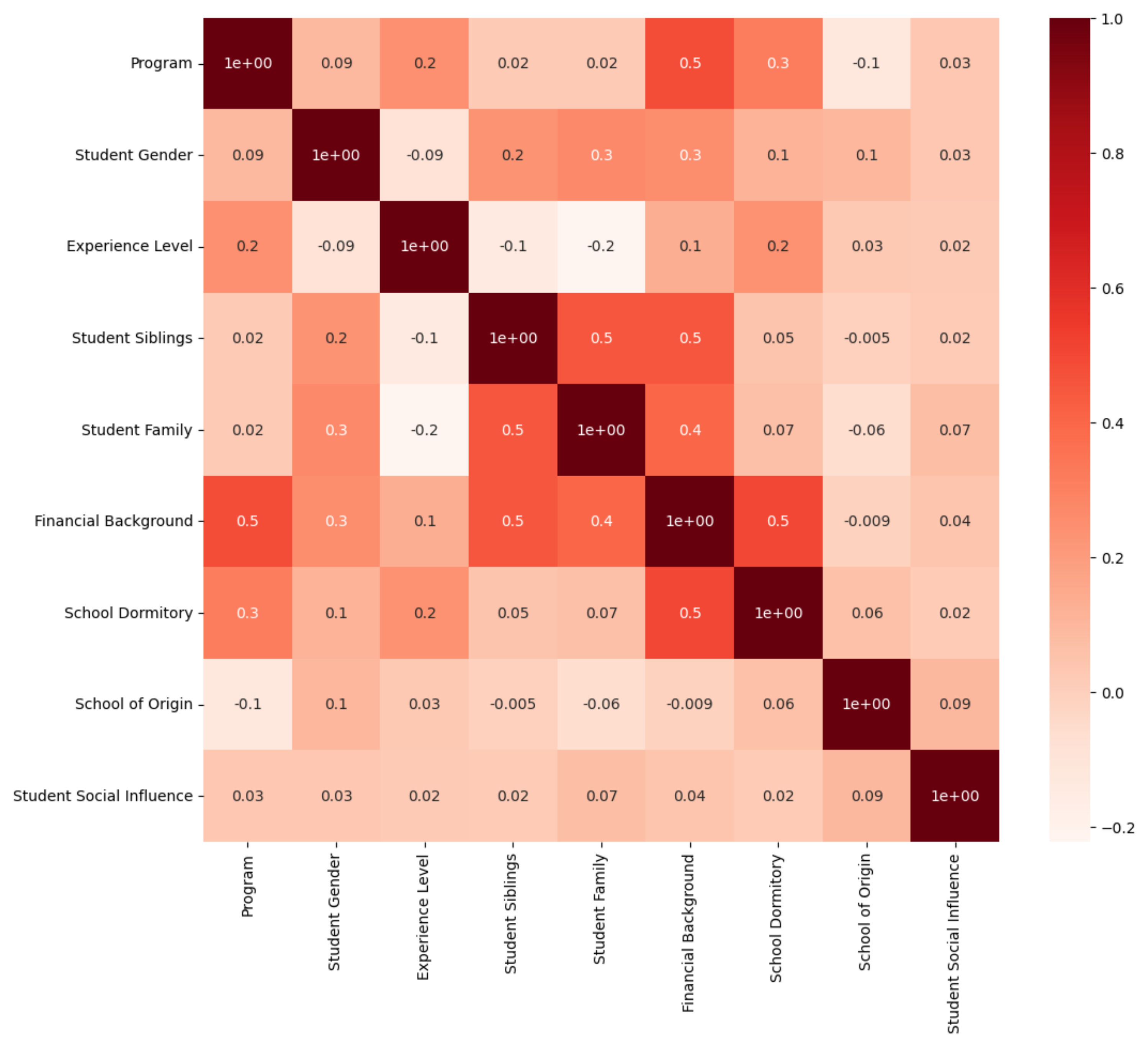
In [ ]:
```python
def cor_heatmap(cor):
    plt.figure(figsize=(12,10))
    sns.heatmap(data = cor, annot = True, cmap = plt.cm.Reds, fmt='.1')
    plt.show()
```

In [ ]:
```python
cor_spearman = X.corr(method ='spearman')
cor_spearman
```

Out[ ]:

	Program	Student Gender	Experience Level	Student Siblings	Student Family	Financial Background	School Dormitory	School of Origin	Student Social Influence
Program	1.000000	0.091574	0.242117	0.021903	0.023696	0.485104	0.316454	-0.119414	0.033376
Student Gender	0.091574	1.000000	-0.085479	0.230445	0.268053	0.257183	0.114238	0.101372	0.034525
Experience Level	0.242117	-0.085479	1.000000	-0.136969	-0.221692	0.131906	0.238594	0.029001	0.024531
Student Siblings	0.021903	0.230445	-0.136969	1.000000	0.455728	0.453019	0.047579	-0.005491	0.018132
Student Family	0.023696	0.268053	-0.221692	0.455728	1.000000	0.401566	0.065432	-0.057013	0.069643
Financial Background	0.485104	0.257183	0.131906	0.453019	0.401566	1.000000	0.498929	-0.009448	0.040961
School Dormitory	0.316454	0.114238	0.238594	0.047579	0.065432	0.498929	1.000000	0.063013	0.018540
School of Origin	-0.119414	0.101372	0.029001	-0.005491	-0.057013	-0.009448	0.063013	1.000000	0.094333
Student Social Influence	0.033376	0.034525	0.024531	0.018132	0.069643	0.040961	0.018540	0.094333	1.000000

In [ ]:
```python
cor_heatmap(cor_spearman)
```



In [ ]:
```python
# Step 4: Division into training and validation set (optional)
X_train, X_val, y_train, y_val = train_test_split(X, y, test_size=0.2, random_state=42)
```

We choose Logistic Regression, because it is a simple yet effective model for binary classification tasks. It's a good starting point because it's easy to implement and interpret, making it suitable for understanding the impact of different features on the admission process.

In [ ]:
```python
# Logistic Regression
lr = LogisticRegression()
lr.fit(X_train, y_train)
y_pred_lr = lr.predict(X_val)
f1_lr = f1_score(y_val, y_pred_lr)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/linear_model/_logistic.py:458: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

We choose Random Forest Classifier, because is an ensemble learning method known for its high accuracy and robustness. It can handle a variety of feature types and is less prone to overfitting. It's suitable when you have a dataset with multiple features of varying importance.

In [ ]:
```python
# Random Forest Classifier
rf = RandomForestClassifier()
rf.fit(X_train, y_train)
y_pred_rf = rf.predict(X_val)
f1_rf = f1_score(y_val, y_pred_rf)
```

We choose Gradient Boosting, because it is an ensemble technique that builds strong predictive models. XGBoost, in particular, is known for its high performance and efficiency. It can capture complex relationships and handle missing data well.

In [ ]:
```python
# Gradient Boosting (XGBoost)
xgb = XGBClassifier()
xgb.fit(X_train, y_train)
y_pred_xgb = xgb.predict(X_val)
f1_xgb = f1_score(y_val, y_pred_xgb)
```

We choose SVM with RBF, because if your data is high-dimensional (many features), SVMs can be effective, particularly if there is a clear margin of separation.

In [ ]:
```python
svm_rbf = SVC(kernel='rbf')
svm_rbf.fit(X_train, y_train)
y_pred_svm_rbf = svm_rbf.predict(X_val)
f1_svm_rbf = f1_score(y_val, y_pred_svm_rbf)
```

In [ ]:
```python
print(f'F1 Score for Logistic Regression: {f1_lr}')
print(f'F1 Score for Random Forest: {f1_rf}')
print(f'F1 Score for XGBoost: {f1_xgb}')
print(f'F1 Score for SVM with RBF Kernel: {f1_svm_rbf}')
```

```
F1 Score for Logistic Regression: 0.7578947368421052
F1 Score for Random Forest: 0.7254901960784313
F1 Score for XGBoost: 0.7378640776699028
F1 Score for SVM with RBF Kernel: 0.4166666666666667
```